

**DRAFT ENGINEERING EVALUATION
INGERSOLL-RAND ENERGY TECHNOLOGIES LLC
PLANT NO. 17998
APPLICATION NO. 15095**

BACKGROUND

Ingersoll Rand Energy Technologies is applying for an Authority to Construct and/or Permit to Operate for the following equipment:

- S-1 MicroTurbine (Cogeneration), Ingersoll Rand Model 250SM, 250 KW, natural gas fired, 3.05 MM Btu/hr, heat input**
- S-2 MicroTurbine (Cogeneration), Ingersoll Rand Model 250SM, 250 KW, natural gas fired, 3.05 MM Btu/hr, heat input**
- S-3 MicroTurbine (Cogeneration), Ingersoll Rand Model 250SM, 250 KW, natural gas fired, 3.05 MM Btu/hr, heat input**
- S-4 MicroTurbine (Cogeneration), Ingersoll Rand Model 250SM, 250 KW, natural gas fired, 3.05 MM Btu/hr, heat input**

The equipment will be located at 5855 Hollis Street, Emeryville, CA 94608. The four MicroTurbines will be used to provide electricity and hot water for an office building (cogeneration). Each MicroTurbine will provide 250 KW of electricity to the building and will be fired on commercial Public Utilities Commission quality natural gas to be supplied by Pacific Gas and Electric Company.

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EMISSIONS SUMMARY

The MicroTurbines being installed as part of this project are California Air Resources Board certified for Distributed Generation under Executive Order DG-009. The emission calculations are based on the California Air Resources Board regulatory limits specified in the certification and under California Code of Regulations, Title 17. Public Health, Division 3. Air Resources, Chapter 1. Air Resources Board, Subchapter 8. Compliance With Nonvehicular Emission Standards, Article 3. Distributed Generation Certification Program, Section 94203

Emissions of criteria pollutants were calculated using the following emission factors.

Compound	Emission Factor	Unit	Reference
NOx	7.00E-02	lb/MW-hr	Distributed Generation Certification (ARB Executive Order DG-009)
CO	1.00E-01	lb/MW-hr	Distributed Generation Certification (ARB Executive Order DG-009)
POC	2.00E-02	lb/MW-hr	Distributed Generation Certification (ARB Executive Order DG-009)
PM10	5.78E-03	lb/MMBtu	Based on Max PG&E Natural Gas Specification for Sulfur of 1 gr/100 scf
SO2	2.80E-03	lb/MMBtu	Based on Max PG&E Natural Gas Specification for Sulfur of 1 gr/100 scf
NPOC	8.90E-03	lb/MMBtu	AP-42 Table 3.1-2a (April, 2000)

Note:

$$\text{PM}_{10} = (1 \text{ gr}/100 \text{ scf})(\text{lb}/7000 \text{ gr})(1/1020 \text{ BTU}/\text{scf})(1 \times 10^6 \text{ Btu}/\text{MMBtu})(132 \text{ lb } (\text{NH}_4)_2\text{SO}_4/32 \text{ lb S}) = 0.00578 \text{ lb}/\text{MMBtu}$$

$$\text{SO}_2 = (1 \text{ gr}/100 \text{ scf})(\text{lb}/7000 \text{ gr})(1/1020 \text{ BTU}/\text{scf})(1 \times 10^6 \text{ Btu}/\text{MMBtu})(64 \text{ lb SO}_2/32 \text{ lb S}) = 0.00280 \text{ lb}/\text{MMBtu}$$

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Emissions calculations are based on the following process information for the MicroTurbines.

Parameter	Value
Turbine Maximum Firing Rate, MMBtu/hr	3.05
Hours Of Operation, hr/yr	8760
Natural Gas Higher Heating Value, Btu/cf	1020
MW	0.25
Calculated Value for a Single MicroTurbine	
Fuel Usage, MMBtu/hr	3.05
Fuel Usage, MMBtu/yr	2.67E+04
Fuel Usage, MMcf/hr	2.99E-03
Fuel Usage, MMcf/yr	2.62E+01
Power, Megawatts	0.25
Calculated Value for all four MicroTurbines	
Fuel Usage, MMBtu/hr	12.2
Fuel Usage, MMBtu/yr	1.07E+05
Fuel Usage, MMcf/hr	1.20E-02
Fuel Usage, MMcf/yr	1.05E+02
Power, Megawatts	1.00

Sample Calculations for a single MicroTurbine are shown below.

$$\text{NO}_x \text{ lb/hr} = (0.07 \text{ lb/MW-hr})(0.25 \text{ MW}) = 0.0175 \text{ lb/hr}$$

$$\text{NO}_x \text{ lb/day} = (0.0175 \text{ lb/hr})(24 \text{ hr/day}) = 0.42 \text{ lb/day}$$

$$\text{NO}_x \text{ lb/yr} = (0.0175 \text{ lb/hr})(8,760 \text{ hr/yr}) = 153.3 \text{ lb/yr}$$

$$\text{CO lb/hr} = (0.1 \text{ lb/MW-hr})(0.25 \text{ MW}) = 0.025 \text{ lb/hr}$$

$$\text{CO lb/day} = (0.025 \text{ lb/hr})(24 \text{ hr/day}) = 0.6 \text{ lb/day}$$

$$\text{CO lb/yr} = (0.025 \text{ lb/hr})(8,760 \text{ hr/yr}) = 219.0 \text{ lb/yr}$$

$$\text{POC lb/hr} = (0.02 \text{ lb/MW-hr})(0.25 \text{ MW}) = 0.005 \text{ lb/hr}$$

$$\text{POC lb/day} = (0.005 \text{ lb/hr})(24 \text{ hr/day}) = 0.12 \text{ lb/day}$$

$$\text{POC lb/yr} = (0.005 \text{ lb/hr})(8760 \text{ hr/yr}) = 43.8 \text{ lb/yr}$$

$$\text{PM-10 lb/hr} = (0.00578 \text{ lb/MMBtu})(3.05 \text{ MMBtu/hr}) = 0.0176 \text{ lb/hr}$$

$$\text{PM-10 lb/day} = (0.0176 \text{ lb/hr})(24 \text{ hr/day}) = 0.422 \text{ lb/day}$$

$$\text{PM-10 lb/yr} = (0.0176 \text{ lb/hr})(8760 \text{ hr/yr}) = 154.2 \text{ lb/yr}$$

$$\text{SO}_x \text{ lb/hr} = (0.0028 \text{ lb/MMBtu})(3.05 \text{ MMBtu/hr}) = 0.00854 \text{ lb/hr}$$

$$\text{SO}_x \text{ lb/day} = (0.00854 \text{ lb/hr})(24 \text{ hr/day}) = 0.205 \text{ lb/day}$$

$$\text{SO}_x \text{ lb/yr} = (0.00854 \text{ lb/hr})(8760 \text{ hr/yr}) = 74.8 \text{ lb/yr}$$

$$\text{NPOC lb/hr} = (0.0089 \text{ lb/MMBtu})(3.05 \text{ MMBtu/hr}) = 0.02715 \text{ lb/hr}$$

$$\text{NPOC lb/day} = (0.02715 \text{ lb/hr})(24 \text{ hr/day}) = 0.65 \text{ lb/day}$$

$$\text{NPOC lb/yr} = (0.02715 \text{ lb/hr})(8760 \text{ hr/yr}) = 237.8 \text{ lb/yr}$$

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Annual and Maximum Daily Criteria Pollutant Emissions

Emissions from a single MicroTurbine.

Compound	Emissions (lb/hr)	Emissions (lb/day)	Emissions (lb/yr)	Emissions (ton/yr)
NO _x	1.75E-02	4.20E-01	1.53E+02	0.077
CO	2.50E-02	6.00E-01	2.19E+02	0.110
POC	5.00E-03	1.20E-01	4.38E+01	0.022
PM ₁₀	1.76E-02	4.23E-01	1.54E+02	0.077
SO ₂	8.54E-03	2.05E-01	7.48E+01	0.037
NPOC	2.71E-02	6.51E-01	2.38E+02	0.119

Emissions from all four MicroTurbines.

Compound	Emissions (lb/hr)	Emissions (lb/day)	Emissions (lb/yr)	Emissions (ton/yr)
NO _x	7.00E-02	1.68E+00	6.13E+02	0.307
CO	1.00E-01	2.40E+00	8.76E+02	0.438
POC	2.00E-02	4.80E-01	1.75E+02	0.088
PM ₁₀	7.05E-02	1.69E+00	6.18E+02	0.309
SO ₂	3.42E-02	8.20E-01	2.99E+02	0.150
NPOC	1.09E-01	2.61E+00	9.51E+02	0.476

Plant Cumulative Increase: (tons/year)

Pollutant	Existing	New	Total
NO _x	0	0.012	0.307
CO	0	0.0036	0.438
POC	0	0.0015	0.088
PM ₁₀	0	0.0002	0.309
SO ₂	0	0.00001	0.150
NPOC	0	0.000	0.476

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Toxic Air Contaminant Emissions

Regulation 2, Rule 5 New Source Review of Toxic Air Contaminants requires a project to conduct a risk screening analysis if emissions of any Toxic Air Contaminant exceed acute or chronic emission trigger levels contained in Table 2-5-1 of the regulation. Based on the Toxic Air Contaminant Emissions calculated for the project the project was required to conduct a risk screening analysis.

Regulation 2, Rule 5 also requires the applicant to apply Toxics Best Available Control Technology (TBACT) to any new or modified source of Toxic Air Contaminants where the source risk is a cancer risk greater than 1.0 in one million (10⁻⁶), and/or a chronic hazard index greater than 0.20. Based on the risk screening analysis presented below the applicant is not required to meet TBACT.

Toxic Air Contaminant emissions from each MicroTurbine were calculated using AP-42 Emission Factors from Table 3.1-3 (April 2000) for Uncontrolled Emission Factors for Stationary Natural Gas Turbines. Formaldehyde emissions were calculated using an emission factor from the California Air Toxics Emission Factors (CATEF) database maintained by the California Air Resources Board. Emissions of Polycyclic Aromatic Hydrocarbons (PAH, assumed to be benzo(a)pyrene) from each MicroTurbine exceeded the Chronic Trigger Level found in Table 2-5-1 from Regulation 2, Rule 5. Emissions of formaldehyde from all four turbines exceeded the Chronic Trigger Level found in Table 2-5-1 from Regulation 2, Rule 5. In accordance with the requirements of Regulation 2, Rule 5 (New Source Review for Toxic Air Contaminants) a risk screening analysis was performed for the project.

The results of the risk screening analysis prepared for the project (dated November 6, 2006) are in accordance with the requirements of Regulation 2, Rule 5. The project would result in a maximum increased cancer risk of 0.693 chances in a million and a chronic hazard index of 0.0046 for nearby residents. The project would result in a maximum increased cancer risk of 0.171 chances in a million and a chronic hazard index of 0.0013 for nearby workers. For the students at Pacific Rim International School, the increased maximum cancer risk is 0.0303 chances in a million and the chronic hazard index is 0.0008. All of the health risk values calculated for this project meet the criteria for acceptable levels established in Regulation 2, Rule 5. The cancer risk associated with the project was less than 10 in a million and acute and chronic hazard indices less than one. The project cancer risk values and hazard index values were also below the TBACT thresholds of one in a million for cancer risk and 0.2 for the hazard index.

The risk screening analysis was based on the emissions data shown below.

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Toxic Air Contaminants Emissions for a single MicroTurbine based on AP-42 Emission Factors from Table 3.1-3 Uncontrolled Emission Factors for Stationary Natural Gas Turbines. Formaldehyde emissions calculated using Emission Factor from CATEF database.

Compound	Emission Factor	Unit	Emissions (lb/hr)	Acute Trigger Level (lb/hr)	Emissions (lb/yr)	Chronic Trigger Level (lb/yr)
1,3-Butadiene	4.30E-07	Lb/MMBtu	1.31E-06	None	1.15E-02	1.10E+00
Acetaldehyde	4.00E-05	Lb/MMBtu	1.22E-04	None	1.07E+00	6.40E+01
Acrolein	6.40E-06	Lb/MMBtu	1.95E-05	4.2E-04	1.71E-01	2.30E+00
Benzene	1.20E-05	Lb/MMBtu	3.66E-05	2.9E+00	3.21E-01	6.40E+00
Ethylbenzene	3.20E-05	Lb/MMBtu	9.76E-05	None	8.55E-01	7.70E+04
Formaldehyde	9.17E-01	lbs/MMcf	2.74E-03	2.1E-01	2.40E+01	3.00E+01
Naphthalene	1.30E-06	Lb/MMBtu	3.97E-06	None	3.47E-02	None
PAH	2.20E-06	Lb/MMBtu	6.71E-06	None	5.88E-02	1.10E-02
Propylene Oxide	2.90E-05	Lb/MMBtu	8.85E-05	6.8E+00	7.75E-01	4.90E+01
Toluene	1.30E-04	Lb/MMBtu	3.97E-04	8.2E+01	3.47E+00	1.20E+04
Xylene	6.40E-05	Lb/MMBtu	1.95E-04	4.9E+01	1.71E+00	2.70E+04

Note: As a conservative estimate for the risk screen calculations the PAH emission rate was assumed to be equal to the benzo(a)pyrene emission rate. Acute and Chronic Trigger Levels are for PAH as benzo(a)pyrene.

Toxic Air Contaminants Emissions for all four MicroTurbine based on AP-42 Emission Factors from Table 3.1-3 Uncontrolled Emission Factors for Stationary Natural Gas Turbines. Formaldehyde emissions calculated using Emission Factor from CATEF database.

Compound	Emission Factor	Unit	Emissions (lb/hr)	Acute Trigger Level (lb/hr)	Emissions (lb/yr)	Chronic Trigger Level (lb/yr)
1,3-Butadiene	4.30E-07	lb/MMBtu	5.25E-06	None	4.60E-02	1.10E+00
Acetaldehyde	4.00E-05	lb/MMBtu	4.88E-04	None	4.27E+00	6.40E+01
Acrolein	6.40E-06	lb/MMBtu	7.81E-05	4.2E-04	6.84E-01	2.30E+00
Benzene	1.20E-05	lb/MMBtu	1.46E-04	2.9E+00	1.28E+00	6.40E+00
Ethylbenzene	3.20E-05	lb/MMBtu	3.90E-04	None	3.42E+00	7.70E+04
Formaldehyde	9.17E-01	lbs/MMcf	1.10E-02	2.1E-01	9.61E+01	3.00E+01
Naphthalene	1.30E-06	lb/MMBtu	1.59E-05	None	1.39E-01	None
PAH	2.20E-06	lb/MMBtu	2.68E-05	None	2.35E-01	1.10E-02
Propylene Oxide	2.90E-05	lb/MMBtu	3.54E-04	6.8E+00	3.10E+00	4.90E+01
Toluene	1.30E-04	lb/MMBtu	1.59E-03	8.2E+01	1.39E+01	1.20E+04
Xylene	6.40E-05	lb/MMBtu	7.81E-04	4.9E+01	6.84E+00	2.70E+04

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Note: As a conservative estimate for the risk screen calculations the PAH emission rate was assumed to be equal to the benzo(a)pyrene emission rate. Acute and Chronic Trigger Levels are for PAH as benzo(a)pyrene.

Sample Calculations for a single MicroTurbine are shown below.

Toxic Air Contaminant lb/hr = Emission Factor lb/MMBtu x 3.05 MMBtu/hr

Toxic Air Contaminant lb/yr = Emission Rate lb/hr x 8,760 hr/yr

Formaldehyde lb/hr = 9.17E-01 lb/MMBtu x 2.99E-03 MMBtu/hr = 2.74E-03 lb/hr

Formaldehyde lb/yr = 2.74E-03 lb/hr x 8,760 hr/yr = 24.0 lb/yr

STATEMENT OF COMPLIANCE

S-1 through S-4 MicroTurbines are not subject to the requirements of Regulation 9, Rule 9 per Reg 9-9-110 because each unit has power output rating of less than 0.3 MW.

S-1 through S-4 MicroTurbines are expected to comply with the SO₂ ground level concentration limitations and general emission limitations contained in Regulation 9-1-301 and 9-1-302 because these units are fired on natural gas with a maximum sulfur content of 1 grain/100 scf.

The project is considered to be ministerial under the District's CEQA regulation 2-1-311 and therefore is not subject to CEQA review. The engineering review for this project requires only the application of standard permit conditions and standard emissions factors and therefore is not discretionary as defined by CEQA (Permit Handbook Chapter 2.3).

The project is located within 1000 feet from Pacific Rim International School which is located at 5521 Doyle Street, Emeryville, CA 94608. The project is subject to the public notification requirements of Reg. 2-1-412, the District shall prepare a public notice and distribute the notice to the parents or guardians of children enrolled in any school within one-quarter mile of the source and to each address within a radius of 1000 feet of the source.

Best Available Control Technology:

In accordance with Regulation 2, Rule 2, Section 301, BACT is triggered for any new or modified source with the potential to emit 10 pounds or more per highest day of POC, NPOC, NO_x, CO, SO₂ or PM₁₀.

Based on the emission calculations above, the owner/operator of S-1 through 4 is not subject to BACT for any pollutant. The California Air Resources Board Distributed Generation (Executive Order DG-009) certification for these units is the basis of the emission limits for this application. The certification is based on the units firing Public Utilities Commission quality natural gas.

Offsets: Offsets must be provided for any new or modified source at a facility that emits more than 10 tons/yr of POC or NO_x. Based on the emission calculations above, offsets are not required for this application.

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PSD, NSPS, and NESHAPS do not apply.

PERMIT CONDITIONS

The MicroTurbines covered by this application are certified by the Air Resources Board for Distributed Generation under Executive Order DG-009. The emission calculations for each MicroTurbine are based upon 24 hr per day, 365 day per year operation, and the permit will not include limits on fuel use or record keeping requirements.

RECOMMENDATION

Issue an Authority to Construct to Ingersoll Rand Energy Technologies, LLC for:

- S-1 MicroTurbine (Cogeneration), Ingersoll Rand Model 250SM, 250 KW, natural gas fired, 3.05 MM Btu/hr, heat input**
- S-2 MicroTurbine (Cogeneration), Ingersoll Rand Model 250SM, 250 KW, natural gas fired, 3.05 MM Btu/hr, heat input**
- S-3 MicroTurbine (Cogeneration), Ingersoll Rand Model 250SM, 250 KW, natural gas fired, 3.05 MM Btu/hr, heat input**
- S-4 MicroTurbine (Cogeneration), Ingersoll Rand Model 250SM, 250 KW, natural gas fired, 3.05 MM Btu/hr, heat input**

EXEMPTIONS

None.

By: _____ Date: 11/17/06
Brian Lusher
Air Quality Engineer II

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